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WATER MANAGEMENT PROGRAM

1988

MARK TWAIN NATIONAL WILDLIFE REFUGE

ANNADA DISTRICT

Clarence Cannon National Wildlife Refuge  
Delair Division  
Gardner Division

Prepared by:

Alan L. Bohndel  
Assistant Refuge Manager

Date: 11/25/87

Submitted by:

Brian Adams  
Refuge Manager

Date: 11/25/87

Concurrence:

Robert S. Shultz  
Project Leader, Mark Twain NWR

Date: 11/30/87

James E. Cummings  
Division Biologist

Date: 5/6/88

Regional Engineer

William A. Kunkin  
Regional Supervisor

Date: \_\_\_\_\_

Date: 7-22-88



## WATER MANAGEMENT PROGRAM - 1988

### PURPOSE

The purpose of this plan is to establish a schedule of operations for manipulation of managed waters of the Clarence Cannon National Wildlife Refuge and the Delair and Gardner Divisions of the Mark Twain National Wildlife Refuge during CY 1988.

### OBJECTIVES

Water management plans for 1988 have been developed to meet the objectives set forth in the Master Plan:

- 1) Provide waterfowl with food, water, and protection during fall and spring months. Waterfowl maintenance objectives set forth in the Refuge Management Plan are 3,000,000 duck use days and 400,000 goose use days.
- 2) Improve and maintain existing habitat for wood duck and mallard production. Production objectives are 150 wood ducks and 300 mallards.
- 3) Provide other migratory species (marsh and shorebirds) with food, water, and protection.

### CLARENCE CANNON NWR

#### General Information

Clarence Cannon NWR is located near Annada, Missouri, and consists of 3,736 acres situated within the Mississippi River floodplain. The refuge currently has twelve manageable moist soil units (MSU's) totaling 1,375 acres, three green tree reservoirs (GTR's) totaling 237 acres, four semi-permanent water bodies totaling 72 acres, 1,124 acres of farmland, and 92 acres of other lands including management facilities, brushland, and forestland. Elevation throughout the refuge varies less than four feet.

Water is supplied to managed units via a ditch system, Crissafulli pump, and a stationary 20,000 gallon per minute pump that pulls water from Bryant's Creek. Timely precipitation and/or high river levels can greatly affect operations by lowering pumping requirements, but it cannot be depended on.

#### 1987 Water Management

Water was drawn from four MSU's in January with the hope that the 2" of ice on the units would fall, bringing the vegetation with it. This would greatly improve the substrate for invertebrates plus make room for the spring rains. The spring rains never developed as anticipated, leaving the MSU's with lower water levels than desired. This was not a successful practice and will not be attempted in the future.

All units evaporated in June or July and precipitation was unusually low all summer. Moist soil units were extremely dry and the vegetation suffered. In June, water was pumped into MSU's 2 and 3 for 125 hours to improve conditions for waterfowl broods and wading birds. The evaporation rate was so high that water levels dropped quickly. Water was again pumped in July after a heavy rain, but after 30 hours it was evident that evaporation was still too high to effectively maintain water levels by pumping.

In September, pumping for the fall migrants began. After 69 hours, the pump broke down and was not repaired until early October. Pumping then resumed and after 469 hours, over 500,000,000 gallons of water were brought into seven moist soil units. Waterfowl use increased dramatically, especially in the mowed portion of MSU 5. Other water management units on the refuge remained dry and received little or no waterfowl use.

#### Maintenance, Rehabilitation, and Development (1987)

Three breaks in the main levee were plugged.

The east levee was rehabilitated by a contractor.

Dikes and levees were mowed as part of the regular maintenance program.

Fifteen acres of dikes and levees were burned as part of the regular maintenance program.

The corrugated metal pipe at Hemphill Crossing was replaced with a concrete box culvert.

The corrugated metal pipe at Goose Pasture was replaced and the stop-log structure was replaced with a screwgate.

A new dike and water control structure were completed on Rabbit Ears.

The Main Ditch Section E was rehabilitated. Woody vegetation, silt, and debris were removed to a depth of three feet.

The head and clutch on the east pump were repaired by a Caterpillar dealer at a cost of \$2,600.

A new dike was constructed on the east side of MSU 7 and a water control structure was placed in the north ditch.

Portions of MSU's 4, 5, 6, and 7 were mowed to set back the invasion of cottonwood, willow, and cocklebur.

## 1988 Water Management Program

### January - August

MSU 7, Goose Pasture, Rabbit Ears, Upper Rabbit Ears, Big Pond (708 acres).

These units are presently dry due to lack of precipitation and lack of fuel for the main pump. All control structures will remain closed throughout the winter and spring to trap precipitation and will be flooded with gravity flow water if the river gets high enough. The units will be allowed to evaporate over the summer.

MSU 4 and Supply Pond (119 acres)

A slow drawdown will begin when shorebirds arrive and will continue until mid-June. This will provide continuous habitat for shorebirds and other species that favor shallow water and mudflats. It will also promote vegetation diversity due to a variety of soil moisture conditions.

MSU 3, MSU 6, MSU 2 (354 acres)

These units contained dense stands of marsh smartweed and cocklebur in 1987. The units became so dry that the smartweed died before maturing and the cocklebur flourished. Water will be held in these units until mid-June, then drawn down over a three week period ending in early July. This late drawdown should favor smartweed and millet and other desirable species. These units will also provide habitat for shore and water birds when MSU 4 and Supply Pond are dry.

MSU 5 (126 acres)

Water will be held in this unit until mid-July and drawn down slowly until August. This will provide habitat for wading birds and serve as brood habitat for waterfowl. In addition, it will flood the cottonwood trees that were mowed in 1987 and retard growth of the cottonwood sprouts.

MSU 1, Crane Pond, Raybourn Slough, Ballbush Pond (85 acres)

These units will hold water all summer for brood habitat. If dry conditions prevail and fuel is available, water may be pumped into MSU 1.

### Main Ditch

The ditch will remain full as long as there is a possibility of future pumping and there is no flood danger. The ditch will be drawn down as needed to drain the moist soil units.

Stevens Landing GTR, Goose Pasture GTR, Crane Pond GTR (237 acres)

These areas are presently dry and will remain dry through the summer.

### September - December

If weather conditions are normal, the following fall schedule will be followed:

In early September all gates will be closed in order to trap precipitation and decrease pumping requirements.

When waterfowl begin to arrive in late September, pumping will begin if needed. Water levels will be raised as waterfowl populations increase until units are flooded to an average depth of 6-12 inches.

If the budget permits, up to 2,500 gallons of fuel will be used to flood a minimum of 600 acres of moist soil units.

The moist soil units will be flooded in the following order:

### September - December

If weather conditions are normal, the following fall schedule will be followed:

In early September all gates will be closed in order to trap precipitation and decrease pumping requirements.

When waterfowl begin to arrive in late September, pumping will begin if needed. Water levels will be raised as waterfowl populations increase until units are flooded to an average depth of 6-12 inches.

If the budget permits, up to 2,500 gallons of fuel will be used to flood a minimum of 600 acres of moist soil units.

The moist soil units will be flooded in the following order:

Supply Pond, MSU 6, MSU 5, MSU 3, MSU 2, MSU 4, Big Pond, MSU 7, Goose Pasture GTR, Crane Pond, Crane Pond GTR, Goose Pasture.

The total flooded area is 1,600 acres.

### Maintenance and Development (1988)

The following projects are planned for 1988:

Prescribe burn levees and dikes according to the Annual Burn Plan.

Carry out maintenance mowing of levees and dikes after July 20, the end of the nesting season. Mowing and spraying of problem areas on the dikes and levees may be conducted earlier to gain control of weed problems.

Repair the Big Pond stoplog structure on the east side and the screw-gate on the west side.

The main levee will be raised to an elevation of 451.5 feet m.s.l. to prevent flood damage to water management facilities. This will provide protection from all but the 1973 flood.

Problem areas in moist soil units will be disced or mowed if budget constraints allow.

### Monitoring and Evaluation

The effects of water manipulation in terms of vegetation response and waterfowl use will be monitored and recorded. Eventually, a computer database will be formed to assist in the evaluation of this data and aid in future management decisions.

Woody plant encroachment will be closely monitored.



APPENDIX A

1987 WEATHER DATA

Month	Precip.	50 Yr. Average	Temp. Extremes		Evaporation
			Max.	Min.	
Jan.	1.35"	1.78"	50°	-16°	No Data
Feb.	Trace	1.80"	66°	18°	No Data
Mar.	3.00"	3.04"	77°	20°	No Data
Apr.	3.03"	3.62"	88°	20°	No Data
May	1.84"	3.81"	91°	45°	4.18"
June	1.36"	4.01"	100°	50°	8.03"
July	4.63"	3.61"	101°	56°	7.80"
Aug.	2.83"	3.46"	104°	44°	7.26"
Sep.	1.67"	3.37"	90°	39°	4.79"
Oct.	0.99"	2.95"	82°	22°	No Data
Nov.		2.42"			No Data
Dec.		2.12"			No Data
Total	20.70"	35.99"			32.06"

## APPENDIX B

### Annual MSU Evaluation

Note: Use days and water level data are for January-October only. This section will be updated in January 1988.



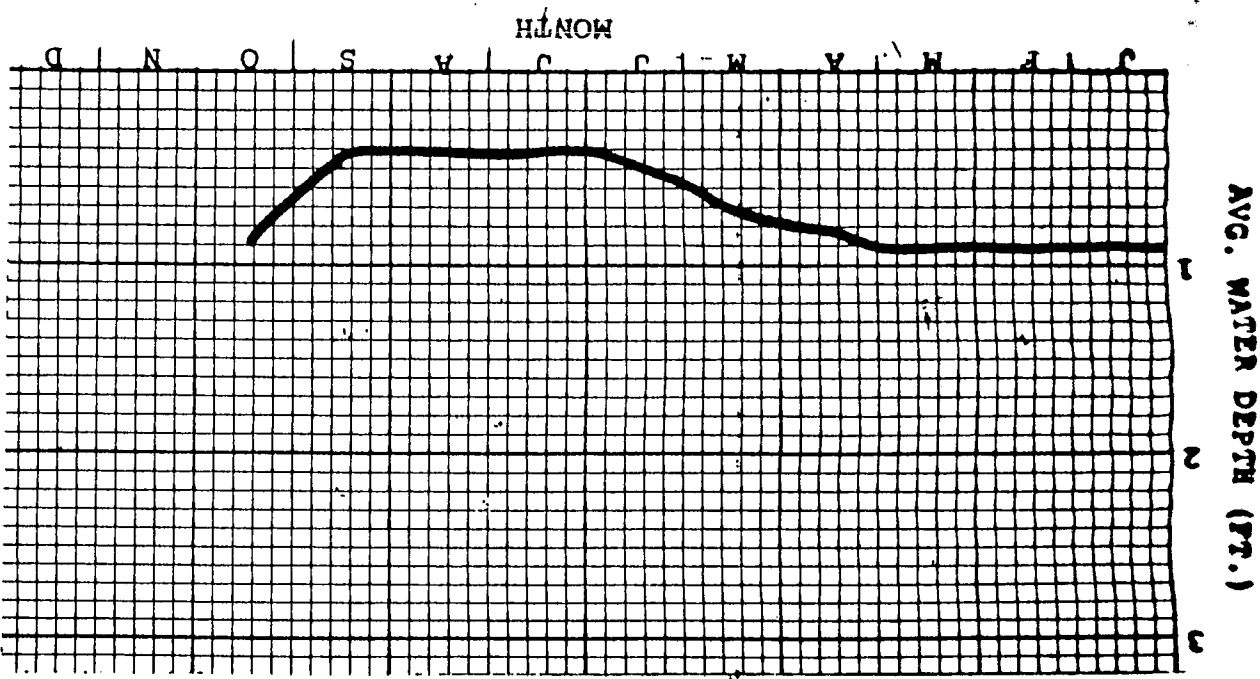
# MARSH AND WATER MANAGEMENT PLAN - ANNUAL MSU EVALUATION

MSU Supply Pond EAR 19 87

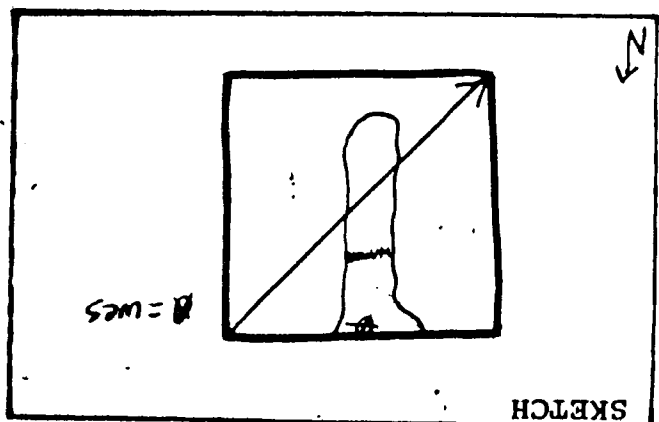
VEGETATIVE TRANSECT DATE 9/14/87

DOMINANT VEGETATION	
8	Tickseed Sunflower
32	Marsh Smartweed
23	Rough Sumpweed
10	Common Cocklebur
7	Longspike Spikerush
6	Blunt Spikerush

Density = 80 stems/m<sup>2</sup>



## SOIL AND VEGETATION TREATMENT



WILDLIFE USE

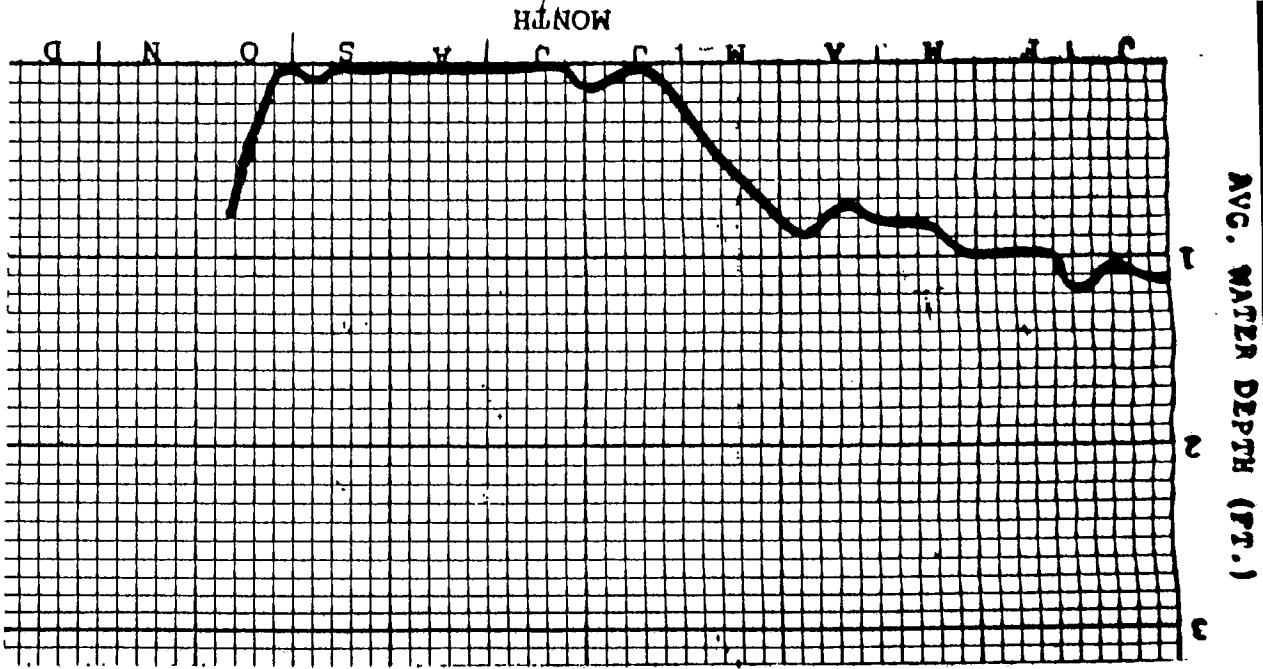
USF	DAYS	FROM 1986
DUCKS	7,928	
GEESSE	2,141	
THR. SPP.		
OTHER MIG.		
WF BROODS:	NO.	
MALLARD	0	
WOOD DUCK	-2	
CHANGE		

VEGETATIVE TRANSECT DATE 9/9/87

DOMINANT VEGETATION

8	Common Cocklebur
32.	Longspike Spikerush
21	Wild Millet
7	Creeping Primrose Willow
7	Blunt Spikerush
7	Sedge

Density = 132 stems/m<sup>2</sup>

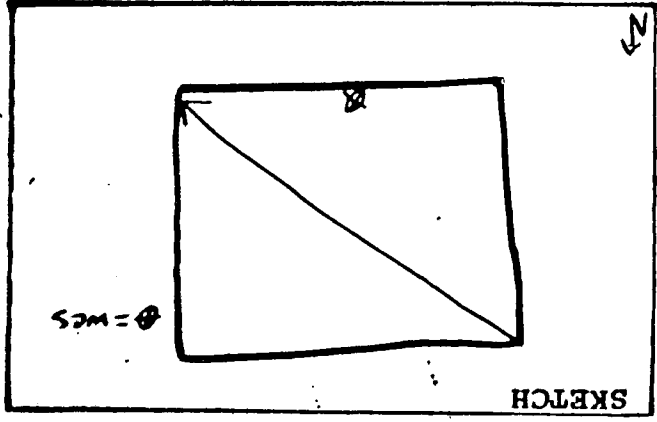


WILDLIFE USE

USE % CHANGE FROM 1986

DUCKS	221,817
GEESE	2,488
THR. SPP.	
OTHER MIG.	
WF BROODS:	
MALLARD	1
WOOD DUCK	2
H. MERGANSER	1

NO. CHANGE  
+1  
+2  
+1

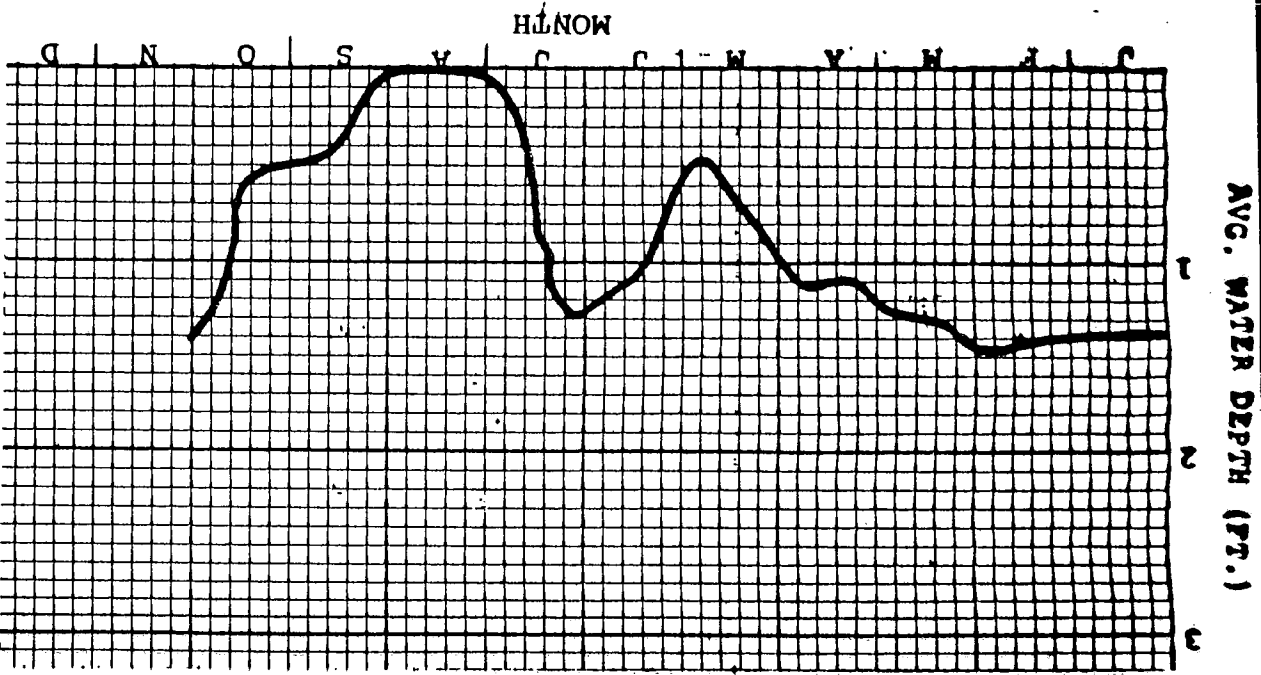


VEGETATIVE TRANSECT DATE 9/22/87

DOMINANT VEGETATION

8	Common Cocklebur
30	Wild Millet
15	Velvetleaf
11	Blunt Spikerush
10	Longspike Spikerush
8	Panicum

Density = 203 stems/m<sup>2</sup>



WILDLIFE USE

USE % CHANGE FROM 19 86

DUCKS 141,398

GESE

THR. SPP.

OTHER MIG.

WE BROODS:

NO.

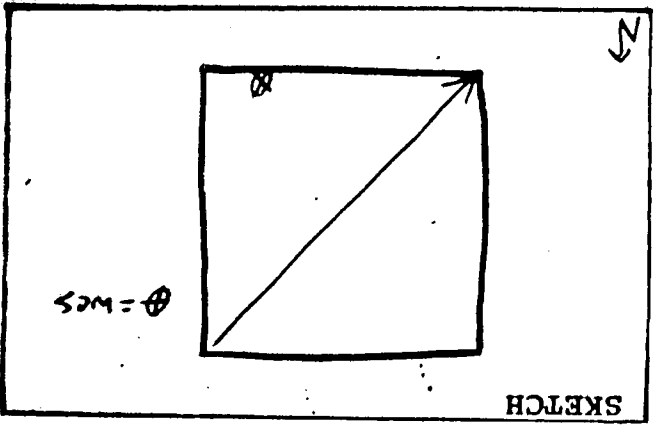
MALLARD

WOOD DUCK

3

+2

CHANGE



# MARSH AND WETLAND MANAGEMENT PLAN - ANNUAL MSU EVALUATION

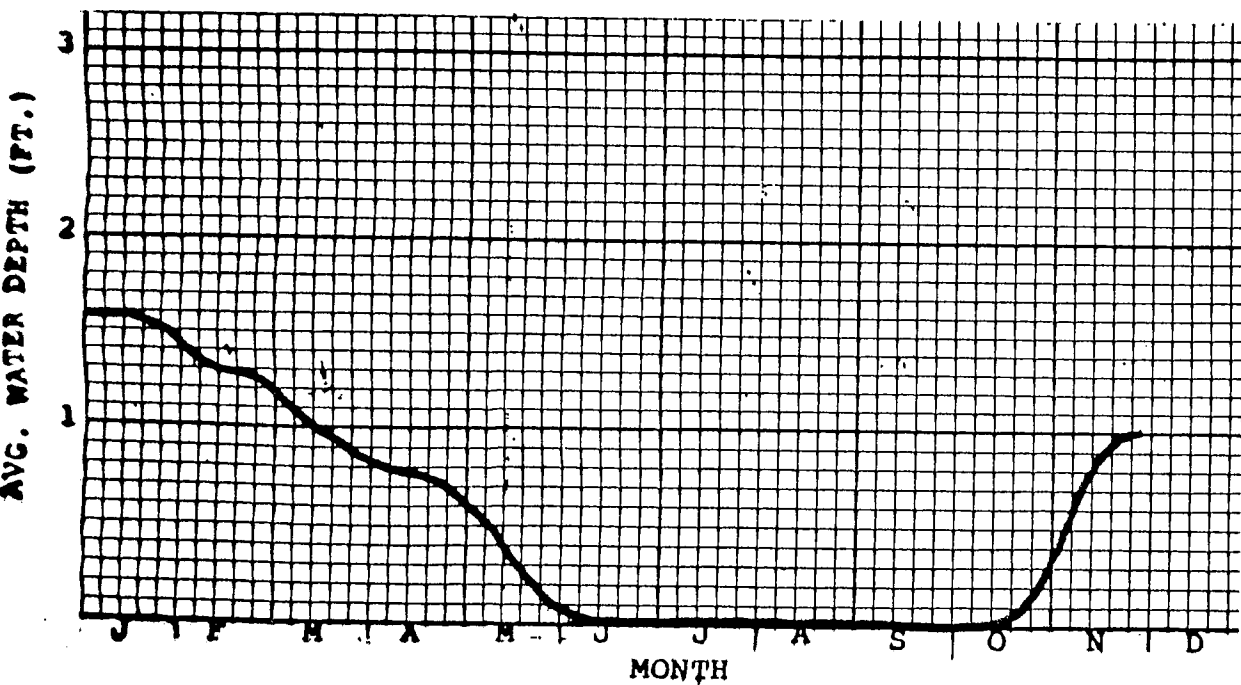
MSU # 3 YEAR 19 87

VEGETATIVE TRANSECT DATE 9/30/87

## DOMINANT VEGETATION

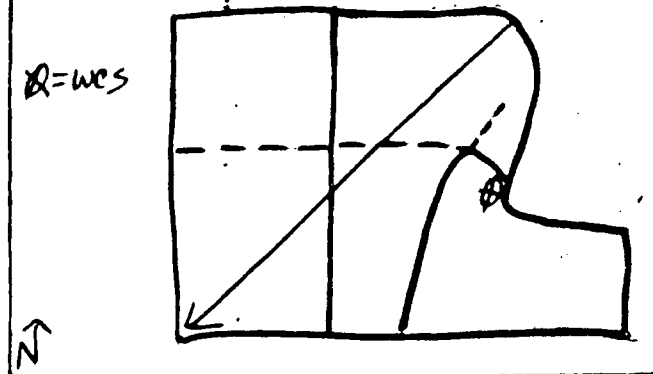
Marsh Smartweed	<u>38</u>
Common Cocklebur	<u>18</u>
Sedge	<u>9</u>
Longspike Spikerush	<u>7</u>
Dodder	<u>7</u>
Rickseed Sunflower	<u>6</u>

Density= 153 stems/m<sup>2</sup>



## SOIL AND VEGETATION TREATMENT

### SKETCH



### WILDLIFE USE

	USE DAYS	% CHANGE FROM 1986
DUCKS	<u>170,781</u>	<u>          </u>
GEESE	<u>24,993</u>	<u>          </u>
THR. SPP.	<u>          </u>	<u>          </u>
OTHER MIG.	<u>          </u>	<u>          </u>
WF BROODS:	NO.	CHANGE
MALLARD	<u>          </u>	<u>          </u>
WOOD DUCK	<u>5</u>	<u>+2</u>

# MARSH AND WATER MANAGEMENT PLAN - ANNUAL MSU EVALUATION

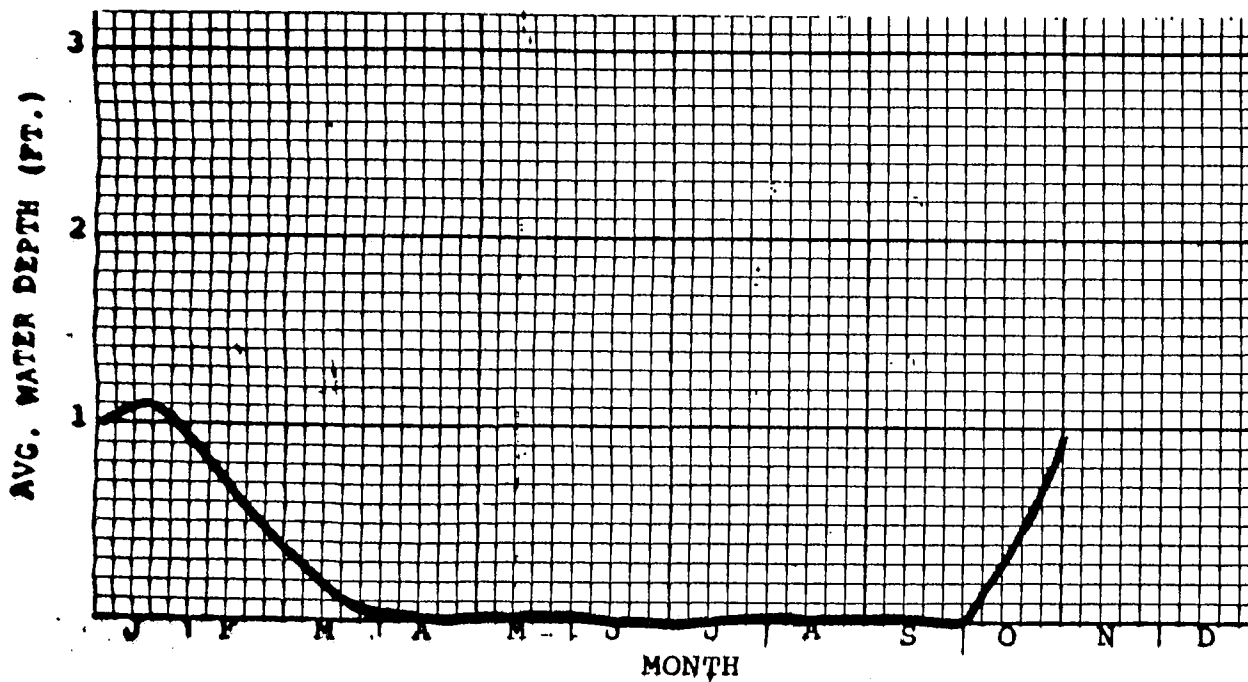
MSU # 4 YEAR 19 87

VEGETATIVE TRANSECT DATE 9/16/87

## DOMINANT VEGETATION

	<u>8</u>
Wild Millet	<u>27</u>
Common Cocklebur	<u>26</u>
Longspike Spikerush	<u>18</u>
Velvetleaf	<u>17</u>
Marsh Smartweed	<u>5</u>
Creeping Primrose/Willow	<u>3</u>

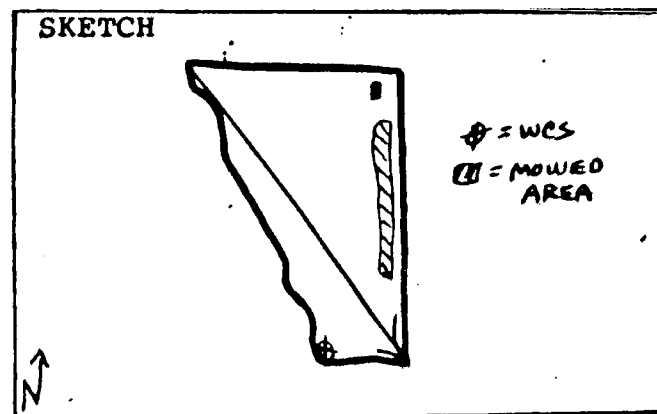
Density = 220 stems/m<sup>2</sup>



## SOIL AND VEGETATION TREATMENT

Mowed in August

## SKETCH



## WILDLIFE USE

	USE DAYS	% CHANGE FROM 1986
DUCKS	<u>49,383</u>	<u>          </u>
GEESE	<u>          </u>	<u>          </u>
THR. SPP.	<u>          </u>	<u>          </u>
OTHER MIG.	<u>          </u>	<u>          </u>
WF BROODS:	<u>NO.</u>	<u>CHANGE</u>
MALLARD	<u>          </u>	<u>          </u>
WOOD DUCK	<u>          </u>	<u>          </u>

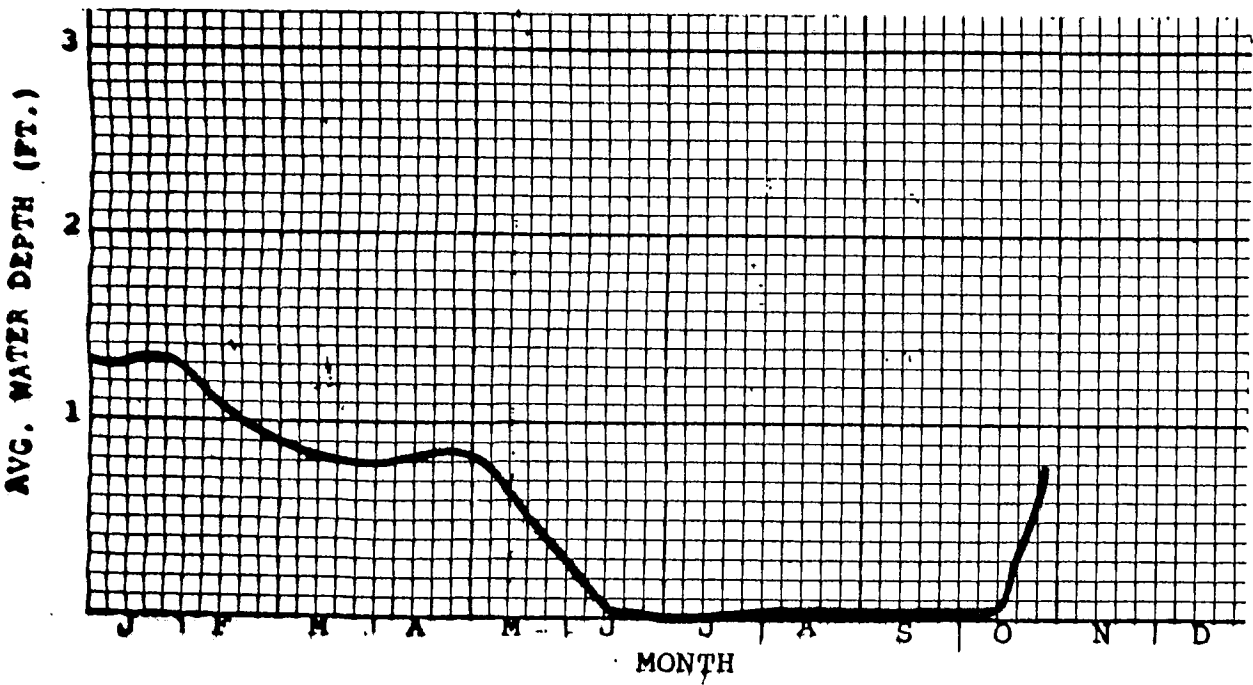
# MARSH AND WATER MANAGEMENT PLAN - ANNUAL MSU EVALUATION

MSU # 5 YEAR 1987

VEGETATIVE TRANSECT DATE 9/2/87

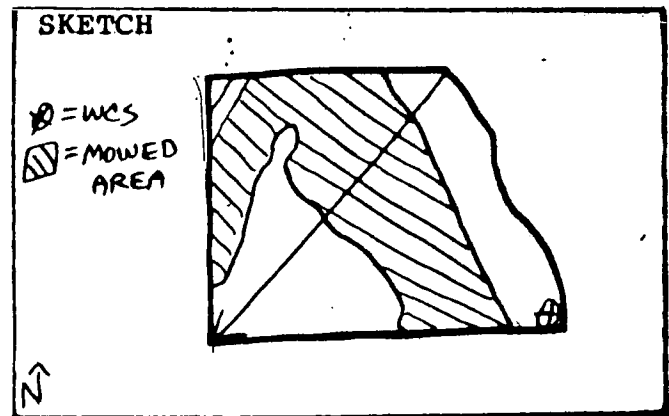
DOMINANT VEGETATION	
	8
Tickseed Sunflower	37
Wild Millet	12
Sedge	6
Blunt Spikerush	6
Bristlegrass	5
Common Cocklebur	5

Density= 106 stems/m<sup>2</sup>



## SOIL AND VEGETATION TREATMENT

Mowed in mid-August



## WILDLIFE USE

	USE DAYS	% CHANGE FROM 1986
DUCKS	64,553	
GEESE	2,430	
THR. SPP.		
OTHER MIG.		
WF BROODS:	NO.	CHANGE
MALLARD	1	+1
WOOD DUCK	5	0
BW TEAL	1	+1
H. MERGANSER	1	+1

# MARSH AND WATER MANAGEMENT PLAN - ANNUAL MSU EVALUATION

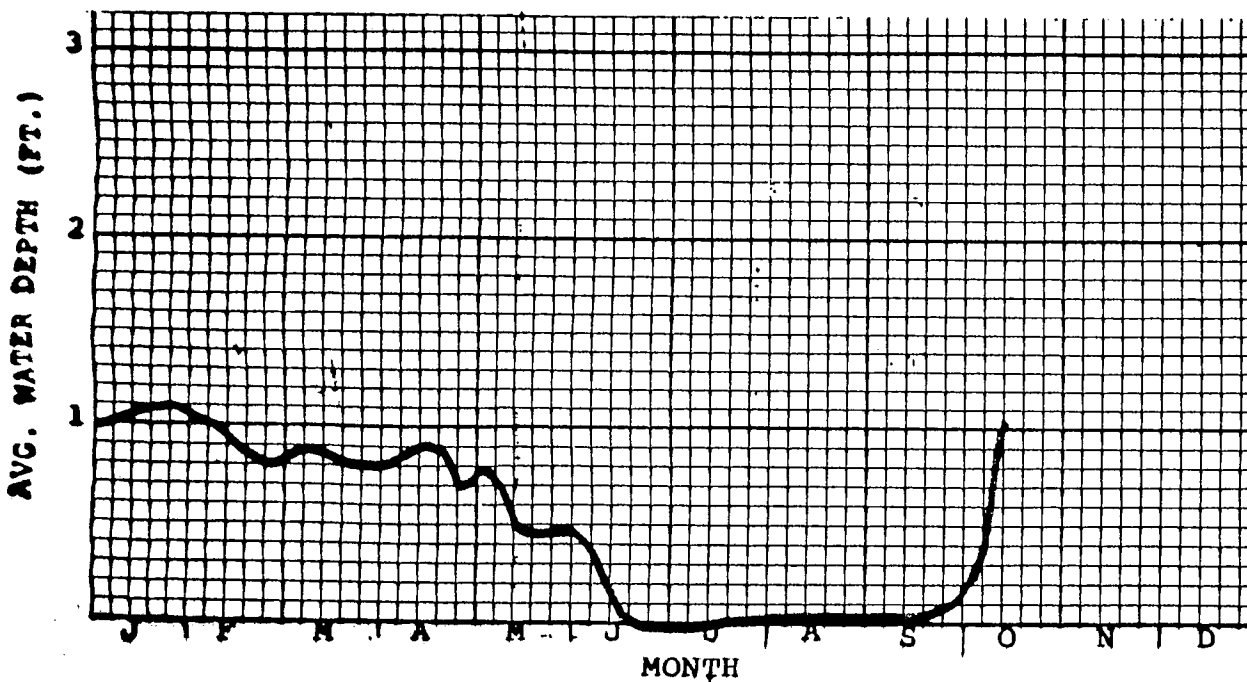
MSU # 6 YEAR 1987

VEGETATIVE TRANSECT DATE 9/3/87

## DOMINANT VEGETATION

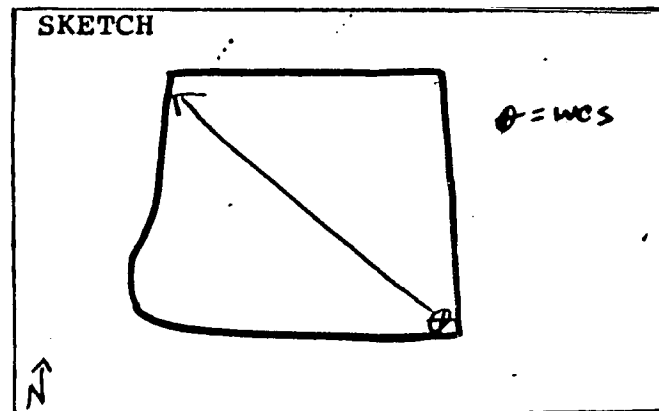
<u>Common Cocklebur</u>	<u>19</u>
<u>Marsh Smartweed</u>	<u>17</u>
<u>Rice Cutgrass</u>	<u>14</u>
<u>Creeping Primrose Willow</u>	<u>10</u>
<u>False Loosestrife</u>	<u>10</u>
<u>Longspike Spikerush</u>	<u>8</u>

Density= 77 stems/m<sup>2</sup>



## SOIL AND VEGETATION TREATMENT

### SKETCH



### WILDLIFE USE

	USE DAYS	% CHANGE FROM 1986
DUCKS	43,948	
GEESE		
THR. SPP.		
OTHER MIG.		
WF BROODS:	NO.	CHANGE
MALLARD	1	-1
WOOD DUCK	3	+2

# MARSH AND WATER MANAGEMENT PLAN - ANNUAL MSU EVALUATION

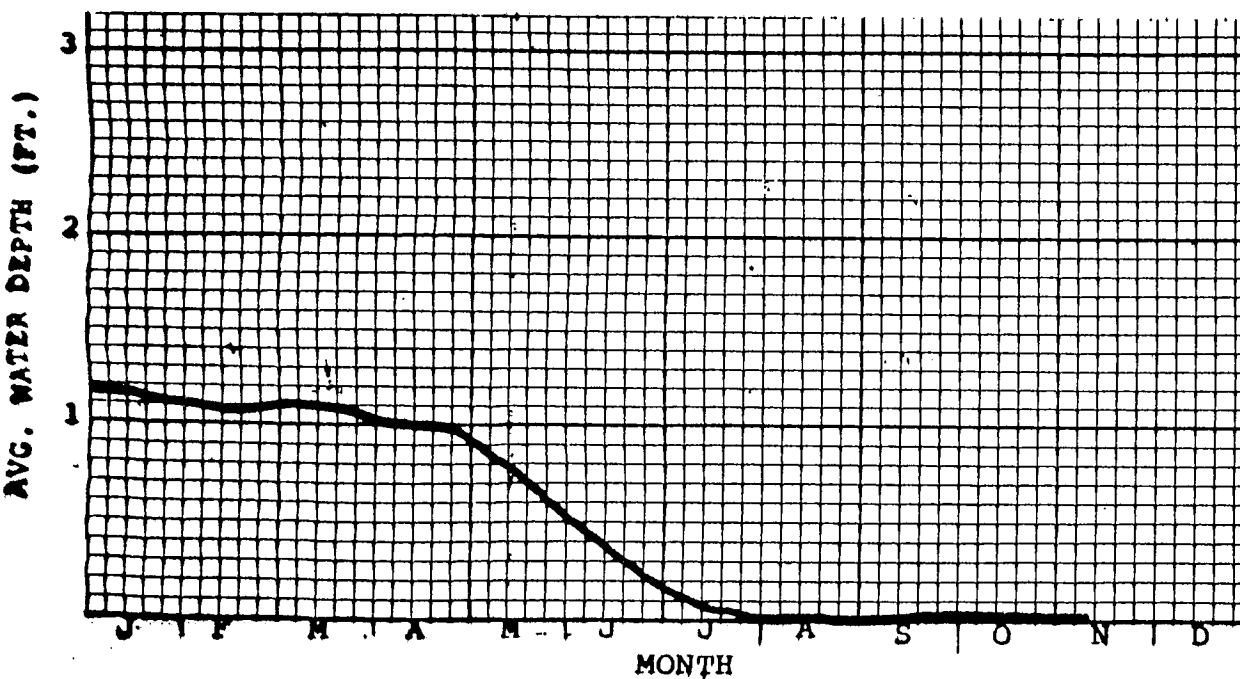
MSU # 7 YEAR 1987

VEGETATIVE TRANSECT DATE 10/6/87

## DOMINANT VEGETATION

Tickseed Sunflower	19
Bristlegrass	12
Common Cocklebur	10
Marsh Smartweed	10
Longspike Spikerush	10
Sedge	7

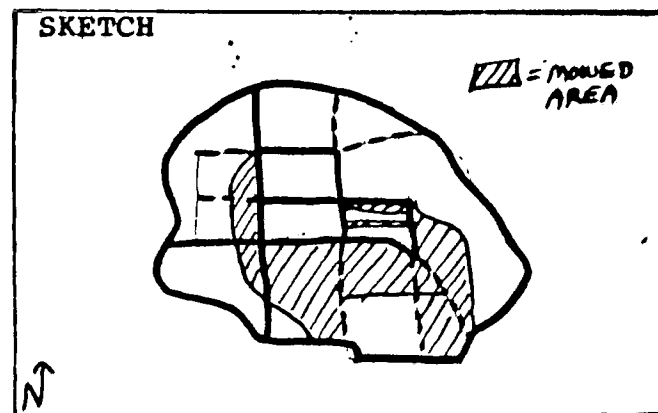
Density= 112 stems/m<sup>2</sup>



## SOIL AND VEGETATION TREATMENT

Mowed in late August

## SKETCH



## WILDLIFE USE

	USE DAYS	% CHANGE FROM 1986
DUCKS	35,601	
GEESE		
THR. SPP.		
OTHER MIG.		
WF BROODS:	NO.	CHANGE
MALLARD	0	-2
WOOD DUCK	6	-2
H. MERGANSER	1	+1



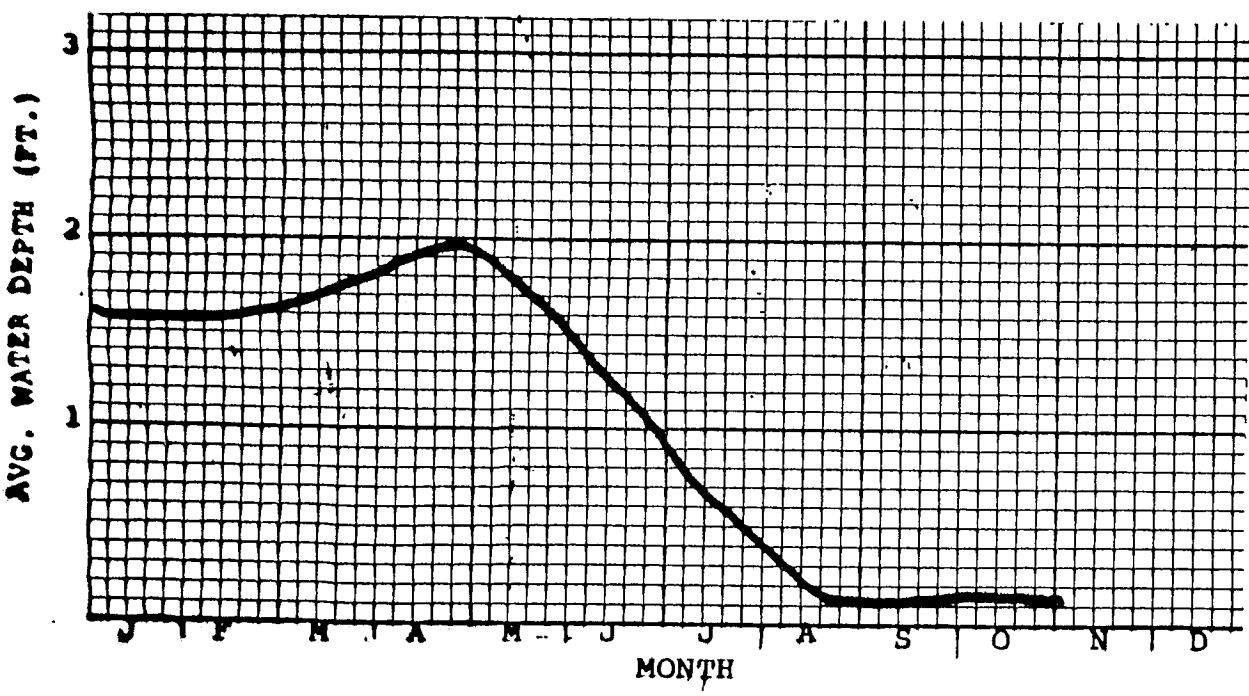
# MARSH AND WATER MANAGEMENT PLAN - ANNUAL MSU EVALUATION

MSU # Big Pond YEAR 1987

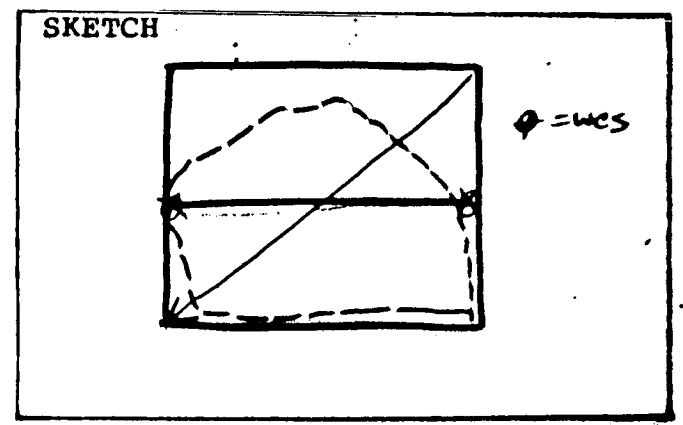
VEGETATIVE TRANSECT DATE 9/22/87

<u>DOMINANT VEGETATION</u>	<u>8</u>
<u>Spotted-Ladythumb</u>	<u>28</u>
<u>Tickseed Sunflower</u>	<u>14</u>
<u>Sedge</u>	<u>12</u>
<u>Marsh Smartweed</u>	<u>10</u>
<u>Partridge Pea Senna</u>	<u>6</u>
<u>Bristlegrass</u>	<u>6</u>

Density= 66 stems/m<sup>2</sup>



## SOIL AND VEGETATION TREATMENT



## WILDLIFE USE

	USE DAYS	% CHANGE FROM 1986
DUCKS	<u>113,493</u>	<u>          </u>
GEESE	<u>48,399</u>	<u>          </u>
THR. SPP.	<u>          </u>	<u>          </u>
OTHER MIG.	<u>          </u>	<u>          </u>
WF BROODS:	NO.	CHANGE
MALLARD	<u>0</u>	<u>-6</u>
WOOD DUCK	<u>          </u>	<u>          </u>

APPENDIX C

Plants found in Clarence Cannon NWR Moist Soil Units in 1987.

<u>Scientific Name</u>	<u>Common Name</u>
Acer saccharinum	Silver maple
Acnida spp.	Water hemp
Albutilon theophrasti	Velvetleaf
Alisma spp.	Waterplaintain
Amaranthus hybridus	Smooth pigweed
Ambrosia artemisifolia	Common ragweed
Ambrosia trifida	Giant ragweed
Ammania coccinea	Tooth-cup
Apocynum cannabinum	Hemp dogbane
Asclepias incarnata	Swamp milkweed
Asclepias syriaca	Common milkweed
Aster spp.	Aster
Bidens aristosa	Tickseed sunflower
Bidens comosa	Leafy-bract bidens
Bidens discoides	Swamp beggar-ticks
Bidens frondosa	Devil's beggar-ticks
Cassia fasciculata	Partridgepea senna
Cuscuta spp.	Dodder
Cyperus spp.	Sedge
Echinochloa spp.	Wild millet
Echinochloa walteri	Walter's millet
Eleocharis macrostachya	Longspike spikerush
Eleocharis obtusa	Blunt spikerush
Eragrostis hypnoides	Pony grass
Erigeron canadensis	Canada horseweed
Helianthus grosseserratus	Sawtooth sunflower
Ipomea hederacea	Ivy-leaved morning glory
Ipomea purpurea	Common morning glory
Iva ciliata	Rough sumpweed
Juncus spp.	Rush
Jussiaea repens	Creeping primrose willow
Leersia oryzoides	Rice cutgrass
Leptochloa spp.	Sprangletop
Lespedeza spp.	Lespedeza
Ludwigia polycarpa	False loosestrife
Lythrum salicaria	Purple loosestrife
Mentha spp.	Mint
Nelumbo lutea	American lotus
Panicum spp.	Panicum
Panicum capillare	Witchgrass panicum
Phyla lanceolata	Fog fruit
Polygonum coccineum	Marsh smartweed
Polygonum lapathifolium	Curltop ladythumb
Polygonum pennsylvanicum	Pennsylvania smartweed
Polygonum persicaria	Spotted ladythumb
Populus deltoides	Eastern cottonwood
Sagittaria spp.	Arrowhead
Setaria spp.	Bristlegrass, foxtail
Typha latifolia	Common cattail
Vernonia spp.	Ironweed
Xanthium strumarium	Common cocklebur

## DELAIR DIVISION

### General Information

The Delair Division is located in Pike County, Illinois, approximately three miles south of the Louisiana, Missouri bridge, adjacent to the navigational Pool No. 24 of the Mississippi River. The area, protected from the river by a levee, is 1,620 acres of cropland, marsh, and water. The amount of land tilled in the past several years averages approximately 650 acres.

Delair has several permanent and semi-permanent water areas: Upper Swan Lake-36 acres, Lower Swan Lake-55 acres, Upper Butcher Pond-8 acres, Lower Butcher Pond-31 acres, Hanei Pool-11 acres, Flake Hole-15 acres, and 15 acres of scattered ponds in farm fields. All of these units except the five scattered ponds, are connected by a drainage system to a central outlet to the Sny Island Drainage District System.

All lands on Delair are one to ten feet below normal pool stage of navigational Pool No. 24. Because of this, water is provided to the area via seeps and gravity flow throughout the year.

Waterfowl maintenance objectives set forth in the Refuge Management Plan include 2,000,000 duck use days and 500,000 goose use days.

### 1987 Water Management

Upper Butcher Pond and Hanei Pool evaporated through the summer and were dry by August. Cattail Marsh was drained by April, when the dredging was completed in the Swan Lakes. Both Swan Lakes were drained in April, but held a few inches of water through the summer. Lower Butcher Pond was drawn down in May to allow the Sny Drainage District to pass through the refuge on the Sny levee.

Vegetation response was excellent in all units (see Appendix A).

Flooding of the Swan Lakes began in September and was completed by October. Hanei Pool and Upper Butcher Pond were flooded by late October and Lower Butcher Pond did not pick up water until November. Waterfowl responded well in all areas. Cattail Marsh and South MSU are almost dry.

### Maintenance, Rehabilitation, and Development

Upper and Lower Swan Lakes were dredged to facilitate draining. Ditches throughout the refuge were rehabilitated in order to restore proper water control. A contractor spread dredge spoil and constructed a small levee around Cattail Marsh.

The Sny Drainage District passed through the refuge with a dozer and dragline to remove silt and debris from the Sny River. The dragline is presently on the refuge but should cross the refuge boundary soon.

A dozer from the Calhoun District is being used to spread the spoil left by the Sny drainage district.

New pipes and water control structures were placed at Lower Butcher Pond and Upper Butcher Pond.

A culvert and water control structure were installed to allow water from Cattail Marsh to enter the south portion of the refuge.

A water control structure was placed at the South MSU to allow draw-down of the MSU or to flood Lower Butcher through the south unit.

The drainage ditch from Garner Slough was diverted to south Swan Lake.

#### 1988 Water Management

##### South MSU and Cattail Marsh (260 acres)

These units are almost dry now due to low river levels and lack of precipitation. Any water gained over the winter and spring will be held until August for brood and wading bird habitat.

##### Upper Butcher Pond (8 acres)

A slow drawdown will begin in mid-May and continue until mid-June. This will provide continuous shorebird and water bird habitat and will promote a diversity of vegetation.

##### Upper and Lower Swan Lakes (91 acres)

These lakes will be drawn down slowly beginning in late June to produce moist soil plants for the fall migration.

##### Hanei Pool and Lower Butcher Pond (42 acres)

These units will hold water throughout the summer for wood duck brood habitat. Evaporation may dry these units by August, providing habitat for wading birds.

#### Maintenance, Development, and Rehabilitation

Levees and dikes will be maintained by mowing and/or burning.

Purple loosestrife will be hand-pulled from Garner Slough, if possible. Chemical control will be used only if necessary.

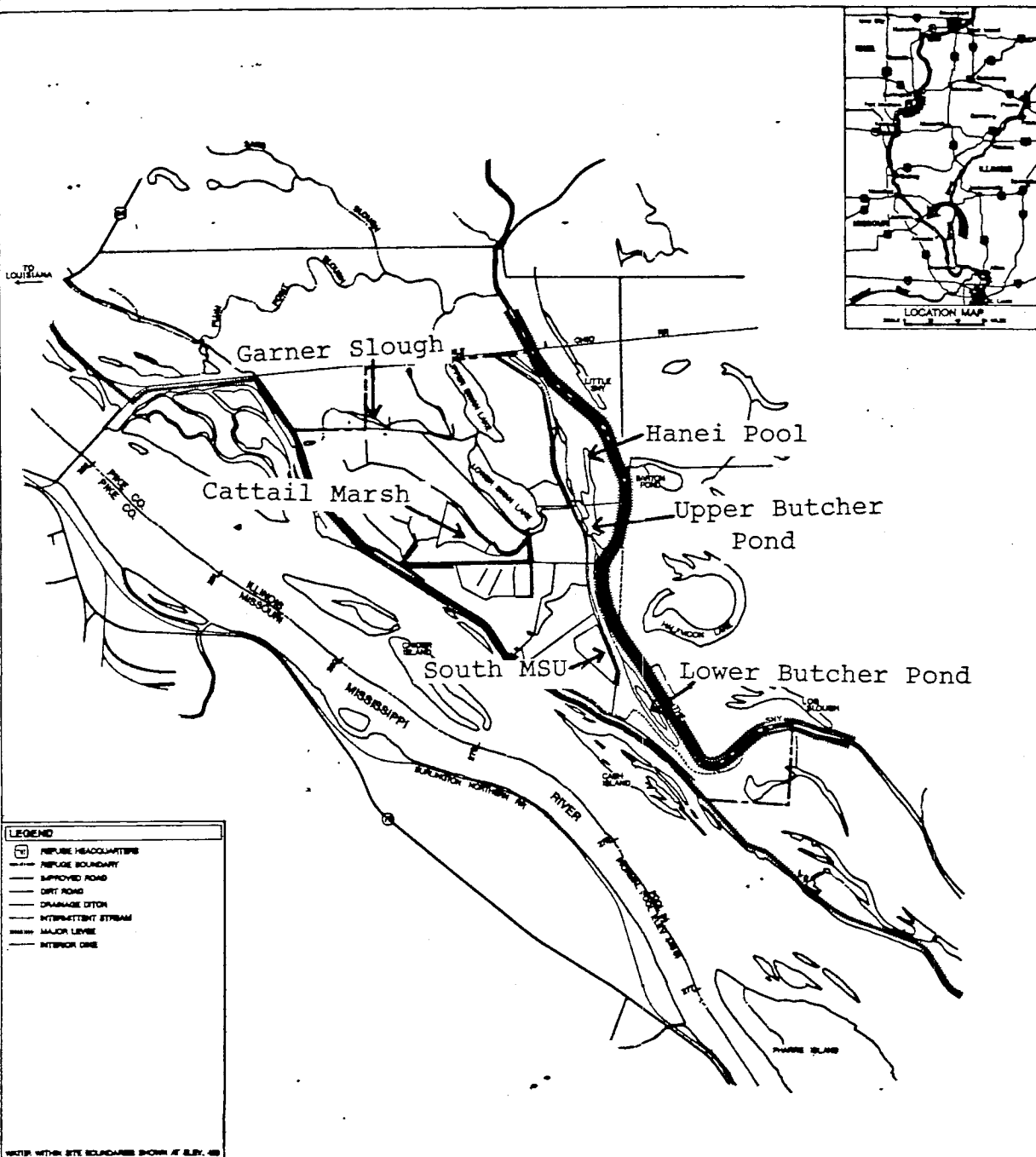
#### Monitoring and Evaluation

Formal vegetation transects will begin in 1988.

The purple loosestrife problem in Garner Slough will be closely monitored and recorded.

The spread of cattail will be monitored in the Swan Lakes.

Vegetation treatment and response will be entered into a computer database to assist in the evaluation of this data and for future management decisions.



**DELAIR DIVISION**  
 MARK TWAIN NATIONAL WILDLIFE REFUGE  
 U.S. FISH AND WILDLIFE SERVICE  
 DEPARTMENT OF THE INTERIOR



# APPENDIX A

Vegetation and Waterfowl Use on the Delair Division, Mark Twain NWR. (This information is current only up to October 31, 1987.)

Unit	Duck Use Days	Goose Use Days	Dominant Vegetation*
Upper Swan Lake	18,634	24,148	Common cattail Sprangletop Walter's millet Wild millet Curltop ladythumb Rice cutgrass Sedge Arrowhead
Lower Swan Lake	138,368	195,386	
Hanei Pool	2,566	21,819	Common cattail Arrowhead Wild millet Walter's millet Rice cutgrass Sprangletop
Upper Butcher Pond	3,671	3,411	Common cattail Rice cutgrass Curltop ladythumb Pennsylvania smartweed Arrowhead Sedge
Lower Butcher Pond	1,661	0	
TOTAL	164,900	244,764	

\* Estimate only---no formal transects were conducted in 1987.

## GARDNER DIVISION

### General Information

The Gardner Division is 6,300 acres of river bottom mainland and 32 adjoining islands in the Mississippi River, Pool No. 21, about six miles upstream from Quincy, Illinois.

This Division of the Mark Twain National Wildlife Refuge is General Plan Lands owned by the U.S. Army Corps of Engineers and cooperatively managed by the U.S. Fish and Wildlife Service.

The Division contains 4,670 acres of mature bottomland hardwoods and 882 acres of croplands. Lakes, sloughs, and ponds existing on the area account for approximately 600 acres.

Access to the majority of the Division is by boat only and, coupled with the great distance from refuge headquarters in Annada, Missouri, limits management activities by refuge personnel.

Waterfowl maintenance objectives set forth in the Master Plan include 1,775,000 duck use days and 3,000 goose use days. Waterfowl production objectives include the annual production of 1,200 wood ducks.

### 1988 Water Management Plan

#### WATER MANIPULATION

Attempts at water management on Gardner, especially moist soil developments, have met with little success in previous years. Sandy soils on the area cause percolation of water from MSU's. Because of its location and low elevation, the area is highly subject to total inundation by untimely rise in the river. Because of these factors and problems with accessibility previously cited, water management on Gardner Division is non-attempted.

#### REHABILITATION

A proposed EMP project will open inland waters to fishermen access, open side channels and stabilize eroding shorelines.